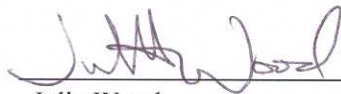
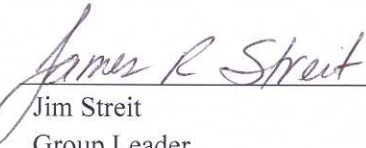
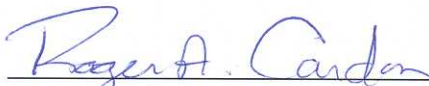

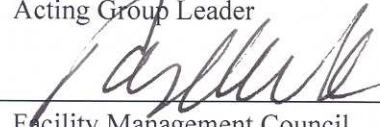


## CRITERION 710

## FOAM-WATER SPRINKLERS

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**RECORD OF REVISIONS**

<b>Revision No.</b>	<b>Date</b>	<b>Description</b>
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## TABLE OF CONTENTS

1.0	PURPOSE .....	1
2.0	SCOPE.....	1
3.0	ACRONYMS AND DEFINITIONS.....	1
3.1	Acronyms .....	1
3.2	Definitions.....	2
4.0	RESPONSIBILITIES .....	3
4.1	FWO-Maintenance Systems Engineering (FWO-MSE) .....	3
4.2	FWO-Fire Protection (FWO-FIRE) .....	4
4.3	Facility Manager.....	4
4.4	Group Leader.....	4
4.5	Support Services Subcontractor .....	4
4.6	Authority Having Jurisdiction (AHJ) – Fire Marshal .....	4
5.0	PRECAUTIONS AND LIMITATIONS.....	5
5.1	Precautions .....	5
5.2	Limitations.....	5
6.0	REQUIREMENTS .....	5
6.1	Operations Requirements .....	6
6.2	Maintenance Requirements .....	10
6.3	Testing.....	14
6.4	Impairments and Modifications.....	17
7.0	RECOMMENDATIONS AND GOOD PRACTICES .....	18
7.1	Operations Recommendations.....	18
7.2	Maintenance Recommendations.....	18
8.0	GUIDANCE .....	18
8.1	Operations Guidance .....	18
8.2	Maintenance Guidance .....	18
9.0	REQUIRED DOCUMENTATION.....	19
10.0	REFERENCES.....	19
11.0	APPENDICES.....	20

**CRITERION 710****FOAM-WATER SPRINKLERS****1.0 PURPOSE**

The purpose of this Criterion is to establish the minimum requirements and best practices for operation, maintenance and inspection of wet-pipe, deluge and preaction foam water sprinklers at LANL.

This document addresses the requirements of LIR 230-05-01(Ref 10.1), "Operations and Maintenance Manual."

Implementation of this Criterion satisfies DOE Order 430.1A (Ref 10.2) for the subject equipment / system – DOE Order 430.1A (Ref 10.2) "Life Cycle Asset Management," Attachment 2 "Contractor Requirements Document," Paragraph 2, Sections A through C, which in part requires UC to "...maintain physical assets in a condition suitable for their intended purpose," and employ "preventive, predictive, and corrective maintenance to ensure physical asset availability for planned use and/or proper disposition." Compliance with DOE Order 430.1A is required by Appendix G of the UC Contract.

**2.0 SCOPE**

The scope of this Criterion includes the routine inspection, testing and preventive and predictive maintenance of wet-pipe, deluge and preaction foam water sprinkler systems at LANL. This Criterion does not address corrective maintenance actions required to repair or replace equipment.

Because LANL only has foam-water sprinkler systems utilizing bladder tank proportioners, this criterion limits O&M requirements to these system configurations. If a new system is installed using other types of proportioning equipment, this Criterion will require revision.

**3.0 ACRONYMS AND DEFINITIONS****3.1 Acronyms**

AFFF	Aqueous Film Forming Foam
AHJ	Authority Having Jurisdiction
CAS	Central Alarm Station
DOE	Department of Energy

FDC	Fire Department Connections
FWO	Facility and Waste Operations
ITM	Inspection, Testing, and Maintenance
LIR	Laboratory Implementing Requirement
LPR	Laboratory Performance Requirement
MSE	Maintenance and Systems Engineering
O&M	Operations and Maintenance
PP&PE	Personal Property and Programmatic Equipment
RP&IE	Real Property and Installed Equipment
SSC	Structures, Systems, and Components
SSS	Support Services Subcontractor
UC	University of California

## 3.2 Definitions

**Aqueous Film-Forming Foam (AFFF) Concentrate.** Synthetic liquid foaming agent provided by approved manufacturers. These concentrates are based on fluorinated surfactants plus foam stabilizers and usually diluted with water to a 1 percent, 3 percent, or 6 percent solution. The foam formed acts as a barrier both to exclude air or oxygen and to develop an aqueous film on the fuel surface capable of suppressing the evolution of fuel vapors.

**Bladder Tank Proportioner.** This system uses a pressure vessel with the foam concentrate contained inside a diaphragm bag that is contained inside the vessel. Suppression water is supplied to the proportioner, which compresses the bladder containing the foam concentrate. Pressurized foam concentrate is then forced through an orifice and injected back into the flowing water stream of the fire suppression system. Because of the separation of the foam concentrate and water, this system can be used with all foam concentrates, regardless of specific gravity.

**Deluge Sprinkler System.** A sprinkler system employing open sprinklers that are attached to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system and discharges from all sprinklers attached thereto. Note that a deluge spray system utilizes spray nozzles, so it is not equivalent to a deluge sprinkler system.

**Management Level Determination (ML1, ML2, ML3, ML4).** A classification system for determining the degree of management control applied to facility work. See LIR 230-01-02 for definitions of each ML level.

**Preaction Sprinkler System.** A sprinkler system that is filled with water only from the underground fire main up to the system control valve and system preaction valve. The piping downstream to the sprinklers is normally dry. A preaction sprinkler system requires actuation of area fire detection to allow water to be released into the piping downstream of the system control valve and preaction valve. Release of water from the system will not occur unless the fusible element on a system sprinkler melts, causing the sprinkler to open.

**Wet Pipe Foam-Water Sprinkler System.** A special fire suppression system that is pipe-connected to a source of foam concentrate and to a water supply. The system is equipped with closed sprinkler heads for extinguishing agent discharge and for distribution over the area to be protected. The piping system is connected to the water supply through a control valve identical to a standard wet pipe sprinkler system. When sprinkler system activates, water flows into the piping system, foam concentrate is injected into the water, and the resulting foam solution discharging through the discharge devices generates and distributes foam. Upon exhaustion of the foam concentrate supply, water discharge follows and continues until shut off manually.

**Wet Pipe Sprinkler System.** A sprinkler system filled with water throughout the system piping (from water supply piping through control valve, main and branch sprinkler piping up to the system's closed sprinklers). Actuation of the system occurs when ambient heat (for example, from a fire) causes a fusible element on a sprinkler to melt, resulting in opening the sprinkler, and releasing water on the source of the heat.

## 4.0 RESPONSIBILITIES

### 4.1 FWO-Maintenance Systems Engineering (FWO-MSE)

- 4.1.1 FWO-MSE is responsible for the administrative content of this Criterion and monitoring the applicability and the implementation status of this Criterion and either assisting the organizations that are not applying or meeting the implementation expectations contained herein or elevating their concerns to the director(s).

*Basis:* LIR 301-00-01.11; Issuing and Managing Laboratory Operations Implementation Requirements and Guidance, Section 5.4, OIC Implementation Requirements.

- 4.1.2 FWO-MSE shall provide technical assistance to support implementation of this Criterion.

**4.2 FWO-Fire Protection (FWO-FIRE)**

- 4.2.1 FWO-FIRE is responsible for the technical content of this Criterion and monitoring the proper implementation across the Laboratory.
- 4.2.2 FWO-FIRE shall provide technical assistance to support implementation of this Criterion.

**4.3 Facility Manager**

- 4.3.1 Responsible for operations and maintenance of institutional, or Real Property and Installed Equipment (RP&IE) under their jurisdiction, in accordance with the requirements of this document.
- 4.3.2 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document that may be assigned to the FM in accordance with the FMU-specific Facility/Tenant Agreement.

**4.4 Group Leader**

- 4.4.1 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) or Real Property and Installed Equipment (RP&IE) systems and equipment addressed by this document that are under their jurisdiction.
- 4.4.2 Responsible for system performance and subsequent replacement or refurbishment of assigned PP&PE and RP&IE.

**4.5 Support Services Subcontractor**

- 4.5.1 Responsible for providing ITM of the fire protection systems addressed in this Criterion at the request of the responsible Facility Manager.
- 4.5.2 Responsible for coordinating work with operating group and Facility Manager to conduct ITM in the affected area.

**4.6 Authority Having Jurisdiction (AHJ) – Fire Marshal**

- 4.6.1 The AHJ is responsible for providing a decision on a specific technical question regarding this Criterion.
- 4.6.2 The LANL Fire Marshal is the approval authority for all exceptions and variances to this Criterion.

## **5.0 PRECAUTIONS AND LIMITATIONS**

### **5.1 Precautions**

This section is not intended to identify all applicable precautions necessary for implementation of this Criterion. A compilation of all applicable precautions shall be contained in the implementing procedure(s) or work control authorization documents. The following precautions are intended only to assist the author of a procedure or work control document in the identification of hazards/precautions that may not be immediately obvious.

### **5.2 Limitations**

The intent of this Criterion is to identify the minimum generic requirements and recommendations for SSC operation and maintenance across the Laboratory. Each user is responsible for the identification and implementation of additional facility specific requirements and recommendations based on their authorization basis and unique equipment and conditions, (e.g., equipment history, manufacturer warranties, operating environment, vendor O&M requirements and guidance, etc.).

Nuclear facilities and moderate to high hazard non-nuclear facilities will typically have additional facility-specific requirements beyond those presented in this Criterion. Nuclear facilities shall implement the requirements of DOE Order 4330.4B (Ref. 10.3) as the minimum programmatic requirements for a maintenance program. Additional requirements and recommendations for SSC operation and maintenance may be necessary to fully comply with the current DOE Order identified above.

## **6.0 REQUIREMENTS**

Minimum requirements that Criterion users shall follow are specified in this section. Requested variances and exceptions to these requirements shall be prepared and submitted to FWO-MSE in accordance with LIR 301-00-02 (Ref. 10.4), "Variances and Exceptions to Laboratory Operations Requirements," for review and approval. The Criterion users are responsible for analysis of operational performance and SSC replacement or refurbishment based on this analysis. Laws, codes, contractual requirements, engineering judgement, safety matters, and operations and maintenance experience drive the requirements contained in this section. Variances and exceptions to this Criterion shall be approved by the LANL Fire Marshal.



## **6.1 Operations Requirements**

### **6.1.1 Operations Checklist**

The foam-water sprinkler system shall remain operational at all times. The foam-water sprinkler system shall be deemed operational when the following conditions are met:

- control valve is in the open position,
- water flow alarm is operational,
- sprinkler heads are unobstructed (ref. NFPA 13, Section 5-6),
- continuous or non-continuous obstructions such as storage and partial-height partitions are at least 18” below sprinkler deflectors,
- where fixed continuous or non-continuous obstructions beneath sprinklers are more than 48” wide [ex., scaffold, platforms, ductwork, cable trays, cutting tables], sprinklers must be provided underneath,
- where intermediate sprinklers might be cooled by sprinklers located above, the intermediate level sprinklers are equipped with spray shields,
- sprinklers are a sufficient horizontal distance from ceiling-height obstructions so that sprinkler spray pattern is not significantly obstructed (use engineering judgment and refer to NFPA 13 for restrictions),
- pendent and upright sprinklers are at least 4” from wall,
- pipings, fittings, hangers, sprinklers, and other components are in their proper locations and in good repair,
- adequate water supply is available (with appropriate water pressure and quantity—compare to previous satisfactory test results),
- foam-concentrate bladder storage tank valve alignment is correct to allow proper operation,
- sufficient foam-concentrate is present with the foam-concentrate bladder storage tank to deliver foam agent over the calculated design for the required duration,
- foam concentrate is of adequate quality to provide intended performance,
- for deluge systems, the fire detection subsystem (typically heat detection or pilot head detection) is in service and connected to the deluge valve activation device, and
- for preaction systems, the associated detection and alarm systems is in-service and connected to the preaction valve activation device.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems Maintenance Requirements. Compliance with this NFPA code is required per Appendix G of the UC contract.

### **6.1.2 Daily Inspections**

Valve enclosure heating equipment, for preaction and deluge valves subject to freezing, shall be inspected DAILY during cold weather for its ability to maintain a minimum temperature of at least 4° C (40° F).

EXCEPTION: Where riser enclosures are equipped with remotely-monitored low temperature alarms, visually inspect riser enclosure heating equipment WEEKLY.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems Maintenance Requirements. Compliance with this NFPA code is required per Appendix G of the UC contract.

### **6.1.3 Monthly Inspections**

Proportioning system shall be inspected for:

- Water control valves to the foam concentrate storage tank and concentrate piping network are free of damage and in the proper position.
- Foam concentrate level in the bladder storage tank(s) is normal via sight glass.
- Manually-operated shut-off valves are correctly positioned and secured.
- Water supply pressure is within normal range.
- Absence of external corrosion on foam concentrate storage tank.
- Water supply system and foam concentrates protected from freezing conditions (protected from temperatures < 40°F).

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems Maintenance Requirements. Compliance with this NFPA code is required per Appendix G of the UC contract.

**6.1.4 Quarterly Inspections****6.1.4.1 System Piping, Fittings, Hangers and Supports**

System piping and fittings shall be inspected for the following:

- a) Mechanical damage (e.g., broken piping or cracked fittings)
- b) External conditions (e.g., missing or damaged paint or coatings, rust and corrosion)
- c) Secure attachment to structural supports and piping.
- d) Damaged or missing hangers and bracing.
- e) Misalignment or trapped sections, proper drainage pitch.
- f) Low point drains (automatic or manual) leaking.
- g) Location and condition of rubber-gasketed fittings

**6.1.4.2 Foam Concentrate Strainers**

Conduct a visual inspection to ensure the blow-down valve is closed and plugged.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems Maintenance Requirements. Compliance with this NFPA code is required per Appendix G of the UC contract.

**6.1.5 Semi-Annual Inspection**

- (a) Visually inspect the systems hydraulic nameplate, if provided, to ensure it is securely attached and legible.

NOTE: The nameplate may contain hydraulic calculation information applicable to the foam-water sprinkler system. If the sprinkler riser does not have a nameplate, this requirement is not applicable.

- (b) Visually inspect foam-water sprinkler system valves, alarm devices, and gauges to verify they are in good condition and free of damage. Verify that valves are in their proper position.
- (c) Visually inspect FDC's semi-annually to verify the following:
  - FDCs are visible and accessible,
  - couplings or swivels are undamaged and rotate smoothly,
  - plugs and caps are in place and undamaged,
  - interior of the connection is unobstructed and valve clapper is operational over its full range when the FDC is plugged or if caps are out of place,
  - gaskets are in place and in good condition,
  - identification signs are in place,
  - check valve is not leaking,
  - the automatic drain valve is in place and operating properly, and

- components are cleaned, repaired, or replaced as necessary in accordance with the manufacturer's instructions.
  - FDC clapper(s) is in place and operating smoothly.
- (d) For deluge systems, inspect deluge valve to verify the following:
- the valve is free of physical damage,
  - the trim valves are in their proper position,
  - there is no leakage from the valve seat, and
  - electrical components are in service.
- (e) For preaction systems, inspect preaction valve to verify the following:
- the valve is free of physical damage,
  - trim valves are in their proper position,
  - there is no leakage from the valve seat, and
  - electrical components are in service.
- (f) Visually inspect system valves to ensure the following:
- Valves are in the correct position (normally open),
  - Valves are locked or supervised,
  - Valves are accessible,
  - Valves are free from external leaks,
  - Valves have appropriate identification, and
  - Manual-actuating valves are in the correct (normally closed) position.
- (g) Inspect gauges to ensure that:
- Gauges have up-to-date calibration,
  - Normal supply-side water pressure is maintained, and
  - Normal supervisory air/nitrogen pressure is maintained (as applicable).

*Basis:*       Equivalency to NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Table 12-1. Compliance with this NFPA code is required per Appendix G of the UC contract.

#### **6.1.6 Annual Inspection**

- (a) The supply of spare sprinklers shall be inspected for:
- the proper number and type of sprinklers (see Section 6.2.1), and
  - a sprinkler wrench for each type of sprinkler.

NOTE: Sprinkler heads are listed or approved for particular foam concentrates. Inspection shall verify that unlisted combinations of sprinkler heads and foam concentrate have not been substituted.

- (b) For deluge and preaction systems, inspect the interior of the deluge valve when the system is trip-tested.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 5 and Chapter 2-2. Compliance with this NFPA code is required per Appendix G of the UC contract

### **6.1.7 5-Year Inspections**

- (a) Internally inspect all alarm valves and their associated strainers, filters and restriction orifices every 5 years until tests indicate that a greater frequency is necessary. to verify the following:
- (b) Visually inspect all check valves internally every 5 years to verify components operate properly, move freely, and are in good condition. Clean, repair or replace the internal components as necessary in accordance with the manufacturer's instructions.
- (c) Internally inspect strainers, filters, and restricted openings every 5 years unless tests indicate that a more stringent frequency is required.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract.

### **6.1.8 Other System Inspections**

- Fire detection and alarm systems integral to foam-water sprinkler systems are inspected in accordance with Criterion 720, Fire Alarm Systems.
- Back-flow preventers installed on water supplies to foam-water sprinkler systems are inspected in accordance with Criterion 406, Cross Connection Control.

## **6.2 Maintenance Requirements**

Ensure all system components are working. Repair or replace any components that fail a test or inspection in accordance with the manufacturer's instructions.

**6.2.1 Sprinklers**

- Replacement sprinklers shall have the appropriate characteristics for the application intended. These characteristics shall include proper:
  - style,
  - orifice size and K factor,
  - temperature rating,
  - coating (if any),
  - deflector type (e.g., upright, pendant, sidewall),
  - listing compatibility with specific foam concentrate,
  - design requirements, and
  - Use only new, listed sprinklers as replacements.

NOTE: Sprinkler heads are listed and approved for particular foam concentrates. Inspection shall verify that unlisted combinations of sprinkler heads and foam concentrate have not been substituted.

- LANL's SSS shall keep a supply of at least six spare foam system compatible sprinklers (proportionally representative of the types and temperature ratings of system sprinklers) for replacement purposes.
- Protect sprinklers covering spray-coating areas against overspray residue.
- Conduct an obstruction investigation for sprinkler systems and yard main piping whenever any of the following conditions exist:
  - plugged piping in sprinkler systems dismantled during building alterations are discovered,
  - failure to flush yard piping or surrounding public mains following new installations or repairs,
  - record of broken public mains in the vicinity exists,
  - abnormally frequent false tripping of a dry pipe valve(s),
  - there is reason to believe that the sprinkler system contains sodium silicate or highly corrosive fluxes in copper systems,
  - a system has been supplied with raw water via the FDC,

- pinhole leaks are found,
- discharge of obstructive materials is found during routine water flow tests,
- foreign materials are discovered in fire pumps or check valves,
- heavy discoloration of water during drain tests or plugging of inspectors test connection is found,
- plugging of sprinklers is discovered,
- following repair of water mains in the vicinity, and
- a system is returned to service after an extended period (normally greater than 1 year).

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, Chapter 13.2. Compliance with this NFPA code is required per Appendix G of the UC contract.

### **6.2.2 Control Valves**

- Annually lubricate the operating stems of outside screw and yoke (OS&Y) valves. Then close and reopen the valve completely to test its operation and distribution of the lubricant. Graphite lubricant is recommended.
- Clean, repair, or replace internal components as needed in accordance with the manufacturer's instructions and deemed by inspection.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract.

### **6.2.3 Foam-Water Components**

- Every 5 years the ball drip (automatic type) drain valves shall be disassembled, cleaned, and reassembled.
- Every 10 years the foam liquid storage tank shall be drained of foam liquid and flushed. (Foam liquid shall be permitted to be salvaged and reused.)
- Every 10 years, the foam concentrate storage tank shall be inspected for internal and external corrosion.
- Every 10 years, the foam concentrate tank shall be hydrostatically tested to the specified working pressure.
- Every 10 years, sight glass, where provided, shall be removed and cleaned.

- Strainer baskets or screens shall be removed and inspected after each operation or flow test.
- Mainline strainers shall be flushed until clear after each operation or flowtest.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract.

#### **6.2.4 Deluge Valves**

- During the annual trip test, thoroughly clean the interior and replace or repair any parts as necessary. Interior cleaning and parts replacement or repair shall be permitted every 5 years for deluge valves that can be reset without removing the faceplate.
- Drain the low points in deluge systems after operation and before the onset of freezing weather.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

#### **6.2.5 Preaction Valves**

- During the annual trip test, thoroughly clean the interior of the preaction valve, and replace or repair any parts as necessary. Interior cleaning and parts replacement or repair shall be permitted every 5 years for preaction valves that can be reset without removing the faceplate.
- Drain the low points in preaction systems after operation and before the onset of freezing weather.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

#### **6.2.6 Other System Maintenance**

- Fire detection and alarm systems integral to foam-water sprinkler systems are maintained in accordance with Criterion 720, Fire Alarm Systems.
- Backflow preventers installed on water supplies to foam-water sprinkler systems are maintained in accordance with Criterion 406, Cross Connection Control.



*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

## **6.3 Testing**

### **6.3.1 Semiannual Testing [twice per year]**

- Test system supervisory device(s), alarm devices, main drain, waterflow alarms.
- Test position of control valves.
- Test the priming water level in supervised preaction systems.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

### **6.3.2 Annual Testing**

- Fully close and reopen the system control valve(s).
- Operational tests shall be conducted to ensure that the foam-water system(s) responds as designed.
- The test procedures shall simulate anticipated emergency events so the response of the foam-water system(s) can be evaluated (e.g., through inspectors test connections).

EXCEPTION: Where discharge from the system discharge devices would create a hazardous condition or conflict with local requirements, an approved alternate method to achieve full flow conditions shall be permitted.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

**6.3.2.1 Deluge Systems**

- (a) In addition to 6.3.2, if it is operationally feasible, trip test each deluge during warm weather in accordance with the manufacturer's instructions.
- Observe water discharge patterns from all open sprinklers to ensure patterns are not impeded by plugging.
  - Observe sprinklers to ensure they are properly positioned. When obstructions occur, clean the piping and sprinklers, and retest the system.
  - Record pressure readings at the hydraulically most remote sprinkler to ensure the water flow has not been blocked. Record a second pressure reading at the deluge valve to ensure an adequate water supply is available. Compare these readings to the hydraulic design pressures to ensure the original system design is met and the water supply is adequate.
- (b) When water cannot be discharged into the piping for test purposes, a main drain test shall be conducted to verify availability of water to the deluge valve and to determine if there has been a change in the condition of the water supply piping and control valves.

NOTE: Maintain records that indicate when the deluge valve was last tripped, the actual tripping time, and the individual and organization conducting the test. These records shall be kept in a location that is readily available for viewing by the AHJ.

- (c) Test low temperature alarms at the start of the heating season, if installed.
- (d) Operate manual actuation devices.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

**6.3.2.2 Preaction Systems**

- In addition to 6.3.2, during warm weather trip test each preaction valve in accordance with the manufacturer's instructions.
- Inspect the interior of the preaction valve when the trip test is conducted.

EXCEPTION: In protected properties where water cannot be discharged into the piping for test purposes, conduct the trip test so it will not require discharge into the piping area.

NOTE: After the trip test, return the system to service in accordance with the manufacturer's instructions.

- Test low temperature alarms at the start of the heating season, if installed.
- Operate manual actuation devices.
- Test automatic supervisory air or nitrogen pressure maintenance devices during the annual preaction or deluge valve trip test in accordance with the manufacturer's instructions.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

#### **6.3.2.3 Foam Concentrate Testing**

- During the full flow foam test through the inspector's test connection, a foam-water sample shall be taken.
- This sample shall be checked by refractometric or other methods (e.g., conductivity testing, both methods are described in the Appendix of NFPA 16) to verify concentration of the solution.
- Concentration shall be within 10% of the acceptance test results but in no case more than 10% below minimum design standards.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

#### **6.3.2.4 Return to Service After Annual Flow Testing**

After the annual flow test, the foam-water system shall be returned to service and the foam concentrate tank shall be replenished to design level.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract.

#### **6.3.3 Other Testing Time Frames**

- Every 5 years, replace gauges or test by comparison to a calibrated gauge and adjust to bring into acceptable calibration.
- (See Appendix A, Sprinkler Testing Requirements for specific requirements.)

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

**6.3.4 Other System Tests**

- Fire detection and alarm systems integral to foam-water sprinkler systems are tested in accordance with Criterion 720, Fire Alarm Systems.
- Backflow preventers installed on water supplies to foam-water sprinkler systems are tested in accordance with Criterion 406, Cross Connection Control.

**6.4 Impairments and Modifications**

If one or more of the operations requirements listed in Section 6.1.1 are not maintained, follow the actions outlined in Criterion 733, Fire Protection System Impairment Control Program.

**6.4.1 Inspection (After an Impairment or Modification)**

Visually inspect the system before returning it to service (See Appendix B, Visual Inspection After Repair Checklist)

**6.4.2 Testing (After an Impairment or Modification)**

- Check the water supply to verify an adequate pressure and volume of water is available at the system connection.
- Test the main drain to verify the control valve is open.
- Test using the inspector's test connection to verify the system's local audible alarm and/or alarm signal to the Central Alarm Station will operate within the required time.
- Hydrostatic test any modified or repaired parts of the system pressure boundary before returning it to service.
- Verify quality and level of foam concentrate if the system has been out of service for 6 months or more.
- Verify operability of integral fire detection systems per Criterion 720.

*Basis:* NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract.

**6.4.2.1 Operational testing and alarm verification will be conducted by SSS personnel, in compliance with LIR 402-910-01, Section 6.0.**

*Basis:* LIR 402-910-01, LANL Fire Protection Program

**7.0 RECOMMENDATIONS AND GOOD PRACTICES**

The information provided in this section is recommended based on acceptable industry practices and should be implemented by each user based on his/her unique application and operating history of the subject systems/equipment.

**7.1 Operations Recommendations**

There are no operational recommendations for this Criterion.

**7.2 Maintenance Recommendations**

- 7.2.1** Persons other than SSS Fire Protection Maintenance personnel may conduct visual inspection requirements identified in this document.

**8.0 GUIDANCE****8.1 Operations Guidance**

No operations guidance available.

**8.2 Maintenance Guidance**

No maintenance guidance available.

## 9.0 REQUIRED DOCUMENTATION

Maintenance history shall be maintained by the FM for wet pipe foam-water sprinklers to include, as a minimum, the parameters listed in the Table 9-1 below:

**Table 9-1 Documentation Parameters**

<b>MAINTENANCE HISTORY DOCUMENTATION PARAMETERS</b>				
<b>PARAMETER</b>	<b>ML 1</b>	<b>ML 2</b>	<b>ML 3</b>	<b>ML 4</b>
<b>System Maintenance Activities</b>				
Repair / Adjustments	X	X	X	X
PM Activities	X	X	X	X
<b>System Equipment Problems</b>				
Failure Dates	X	X	X	X
Failure Root Cause	X	X	X	X
<b>System Inspection Results (per this Criterion)</b>				
Inspection Date	X	X	X	X
SSC Condition	X	X	X	X

*Basis:* Documentation of the parameters listed in Table 9-1 above satisfies the requirements of LPR 230-07-00, Criteria 2, (Ref. 10.5) which states; "Maintenance activities, equipment problems, and inspection and test results are documented."

## 10.0 REFERENCES

The following references, and associated revisions, were used in the development of this document.

- 10.1** DOE O 430.1A, Attachment 2 "Contractor Requirements Document" (Paragraph 2, Sections A through C), a requirement of Appendix G of the UC Contract.
- 10.2** DOE Order 433.1, Maintenance Management Program for DOE Nuclear Facilities.
- 10.3** LIR 230-01-02.2, Graded Approach for Facility Work
- 10.4** LIR 230-05-01.0, Operations and Maintenance Manual.
- 10.5** LIR 301-00-02.0, Variances and Exceptions to Laboratory Operation Requirements.
- 10.6** LIR 402-910-01.4, LANL Fire Protection Program
- 10.7** LPR 230-07-00, Maintenance History, Performance Criteria [2].

**10.8** NFPA 16, 1999 Edition Standard for Deluge Foam-Water Sprinkler Systems and Foam-Water Spray Systems

**10.9** NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems.

**11.0 APPENDICES**

**Appendix A:** Sprinkler Testing Requirements

**Appendix B:** Visual Inspection after Repair Checklist

## **Appendix A**

### **Sprinkler Testing Requirements**

(Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems, Section 5.3)

1. Where required below, sample sprinklers shall be submitted to a recognized testing laboratory acceptable to the authority having jurisdiction for field service testing.
  - Where sprinklers have been in service for 50 years, they shall be replaced or representative samples from one or more sample areas shall be tested. Test procedures shall be repeated at 10-year intervals.
  - Sprinklers manufactured using fast-response elements that have been in service for 20 years shall be tested. They shall be retested at 10-year intervals.
  - Representative samples of solder-type sprinklers with a temperature classification of extra high 163°C (325°F) or greater that are exposed to semi-continuous to continuous maximum allowable ambient temperature conditions shall be tested at 5-year intervals.
  - Where sprinklers have been in service for 75 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory acceptable to the authority having jurisdiction for field service testing. Test procedures shall be repeated at 5-year intervals.
  - Dry sprinklers that have been in service for 10 years shall be tested or replaced. If maintained and serviced, they shall be retested at 10-year intervals.
  - Where sprinklers are subjected to harsh environments, including corrosive atmospheres and corrosive water supplies, on a 5-year basis, sprinklers shall either be replaced or representative sprinkler samples shall be tested.
  - Where historical data indicates, longer intervals between testing shall be permitted.
2. A representative sample of sprinklers for testing per 1 above shall consist of a minimum of not less than 4 sprinklers or 1 percent of the number of sprinklers per individual sprinkler sample, whichever is greater.
3. Where one sprinkler within a representative sample fails to meet the test requirement, all sprinklers represented by that sample shall be replaced.



**Appendix B****Visual Inspection After Repair Check List**

1. Inspect piping and joints for proper alignment.
2. Ensure material and method of repair is acceptable.
3. Check the system for leaks.
4. Ensure pipe hangers are adequate.
5. If sprinkler heads were replaced, ensure the type and temperature ratings meet the original specifications.